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Plastic Surgical Face Recognition Using Multimode Approach

Vaibhav R. Wagare[1], Harish K. Bhangale[2]

ME Student, Dept. of Electronics (Digital Electronics), G.H.R.I.E.M., Jalgaon, Maharashtra, India[1]

HOD, Dept. of Electronics (Digital Electronics), G.H.R.I.E.M., Jalgaon, Maharashtra, India[2]

ABSTRACT: Widespread acceptability and use of biometrics for person authentication has instigated several techniques for evading identification. One such technique is altering facial appearance using surgical procedures that has raised a challenge for face recognition algorithms. Increasing popularity of plastic surgery and its effect on automatic face recognition has attracted attention from the research community. However, the nonlinear variations introduced by plastic surgery remain difficult to be modelled by existing face recognition systems. Basically, plastic surgery procedure introduces skin texture variations between images of the same person (intraface) thereby making recognition more difficult than in normal scenario. Since the shape of significant face features such as eyes, nose, eyebrow and mouth remains unchanged even after plastic surgery.

In this research, a multimodal approach (PCA & LBP algorithm) is proposed to match face images before and after plastic surgery. The algorithm first generates non-disjoint face granules at multiple levels of granularity. The granular information is assimilated using a multi objective genetic approach that simultaneously optimizes the selection of feature extractor for each face granule along with the weights of individual granules.

KEYWORDS: Matlab, Face recognition, Plastic surgery, Face representation.

I.INTRODUCTION

According to the statistics provided by the American Society for Aesthetic Plastic Surgery for year 2010, there is about 9% increase in the total number of cosmetic surgery procedures, with over 500,000 surgical procedures performed on face. Transmuting facial geometry and texture increases the intra class variability between the pre- and post-surgery images of the same individual. Therefore, matching post-surgery images with pre-surgery images becomes an arduous task for automatic face recognition algorithms. The face recognition under unconstrained conditions results in faces, which are termed the unconstrained faces.[2] Typically, unconstrained faces include faces that are subject to factors such as changes in expression, pose, illumination and recently introduced variations due to plastic surgery. The problem of pose, expressions and illumination in face recognition has been addressed in a good number of literatures. However, there has been insufficient literature on the recognition of surgically altered faces. Like the effect of changes in illumination direction, plastic surgery procedures induce intra face (face image versions of the same person) dissimilarity, which are obstruction to robust face recognition. . The much attention given to face recognition within the research and commercial community can be associated with its real-world application potentials in areas such as forensics, surveillance, and home land security. Among the most challenging tasks for face recognition in these application scenarios is the development of robust face recognition systems.[16]

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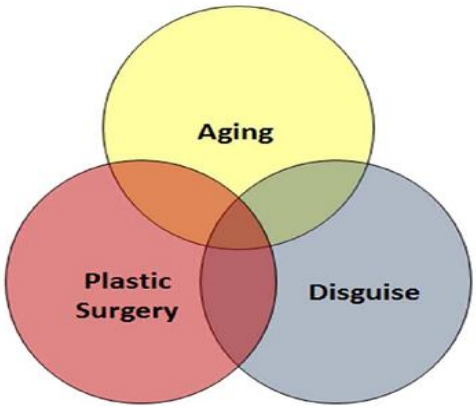

Fig. 1 Relation among plastic surgery, aging, and disguise variations with respect to face recognition

Further, as shown in Fig. 2, it is our assertion that variations caused due to plastic surgery have some intersection with the variations caused due to aging and disguise. Facial aging is a biological process that leads to gradual changes in the geometry and texture of a face. Unlike aging, plastic surgery is a spontaneous process and its effects are generally contrary to that of facial aging. Since the variations caused due to plastic surgery procedures are spontaneous, it is difficult for face recognition algorithms to model such non uniform face transformations. The main focus of this paper is to address the recognition problem that arises when there will be plastically surgical face.

II. LITERATURE SURVEY

Samarth Bharadwaj attention increasing popularity of plastic surgery and its effect on automatic face recognition has attracted attention from the research community. However, the nonlinear variations introduced by plastic surgery remain difficult to be modelled by existing face recognition systems[1]. In this research, a multi objective evolutionary granular algorithm is proposed to match face images before and after plastic surgery. The algorithm first generates non-disjoint face granules at multiple levels of granularity. The granular information is assimilated using a multi objective genetic approach that simultaneously optimizes the selection of feature extractor for each face granule along with the weights of individual granules.

Mayank Vatsa advancement and affordability is leading to the popularity of plastic surgery procedures. Facial plastic surgery can be reconstructive to correct facial feature anomalies or cosmetic to improve the appearance[2]. Both corrective as well as cosmetic surgeries alter the original facial information to a large extent thereby posing a great challenge for face recognition algorithms. 1) Preparing a face database of 900 individuals for plastic surgery, and 2) providing an analytical and experimental underpinning of the effect of plastic surgery on face recognition algorithms.

Rajesh Kumar Gupta proposed the Principal Component Analysis (PCA) which decomposes a face image into a small set of characteristic feature images called eigenfaces and recognition is performed by projecting a new face onto a low dimensional linear "face space" defined by the eigenfaces, followed by computing the distance between the resultant position in the face space and those of known face classes[4]. The objective of the Principal Component Analysis (PCA) is to take the total variation on the training set of faces and to represent this variation with just some little variables. When we are working with great amounts of images, reduction of space dimension is very important. PCA intends to reduce the dimension of a group or space so that the new base describes the typical model of the group. The image space is highly redundant when it describes faces. This happens because each pixel in a face is highly correlated to the others pixels. The objective of PCA is to reduce the dimension of the work space.

Di Huang Local binary pattern (LBP) is a nonparametric descriptor, which efficiently summarizes the local structures of images. In particular for facial image analysis, including tasks as diverse as face detection, face recognition, facial expression analysis, and demographic classification.[5]represents a comprehensive survey of LBP methodology, including several more recent variations. As a typical application of the LBP approach, LBP-based facial image analysis is extensively reviewed, while its successful extensions, which deal with various tasks of facial image analysis, are also highlighted. During the development of LBP methodology, a large number of variations are designed to

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expand the scope of application, which offer better performance as well as improve the robustness in one or more aspects of the original LBP.

III.PROPOSED WORK

Today there is a widespread acceptance that cosmetic surgery is beneficial and even desirable, and given this increasing realization, the number of plastic surgery operations undertaken around the globe has soared within the last several decades. However, one of the fears that has resulted from this craze of re-inventing one's appearance, is that of personal identity disposability [17] where a person might dispose of his/her identity by undergoing surgical operations that change their facial structure and/or features to such a degree, that it renders them unrecognizable, and they appear to be a completely different person. Identity disposal offers new challenges for face recognition and identity confirmation. For example, experimental results from [2] show that traditional face recognition methods are not suitable for the post-surgery face recognition problem and that the accuracy drops significantly. The reason that traditional methods give a much lower accuracy on post-surgery face recognition is that the facial features extracted and trained for recognition, may be altered by plastic surgery procedures; and thus the classifier is not always able to capture the changes. As per the results presented in [2] the drop in accuracy ranges from 30% to 60% depending on the face recognition technique in question.

Following diagram shows the image recognition which are surgically altered.

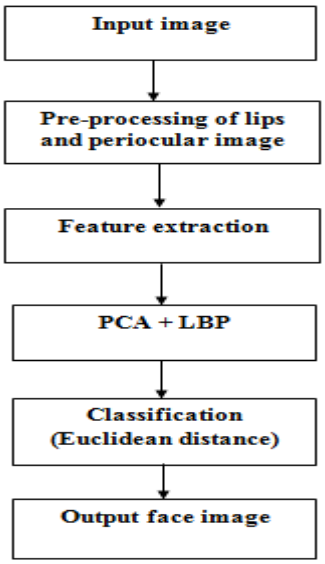

Fig 2. Surgical face recognition

A. Source of Data Collection

The database consists of different types of facial plastic surgery cases such as rhinoplasty (nose surgery), blepharoplasty (eyelid surgery), brow lift, skin peeling, and rhytidectomy (face lift).In the real world, it is difficult to isolate individuals who have undergone plastic surgery and use special mechanism to recognize them. Therefore, face recognition algorithms should be robust to variations introduced by plastic surgery even in general operating environments. Considering such generality of face recognition. Data required for face recognition across plastic surgery is collected from plastic surgery database online which contain pre-surgery and post-surgery images of face with frontal pose, proper illumination, and neutral expression. For Non-surgical face recognition, any database which is freely available on web is used. Some data based collected from we own. Means we took real photos and making them like a plastic surgery face and recognized.

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B. Pre-processing

The images taken for recognition have to be pre-processed before doing actual operation on them. Image pre-processing, also called restoration of image, and involves the correction of distortion, degradation, and noise introduction during the imaging process. Image pre-processing is the term for operations on images at the lowest level of abstraction. Pre-processing operations are not meant to increase image information content, they are meant to extract the useful information and suppress the undesired distortions or enhances some image features relevant for further processing and analysis task. After the input image is taken, in the pre-processing step each and every neighborhood pixel of an input image should have a new brightness value corresponding to the yield image. Such operations are also known as filtration. The periocular region from the face images were obtained using detection of eyes and lips region of face images. In this first normalization of face image is done and then pre-processing is performed on the normalized image. This periocular regions then going through algorithm (i.e. PCA and LBP).

C. Principal Component Analysis

In face recognition PCA has been extensively used. Primarily, for reducing the number of variables. Suppose we have an image and wish to compare this with a set of date base image to find the best match. Each pixel can be considered a variable thus we have a very high dimensional problem which can be simplified by PCA. PCA is usually referred to in tandem with eigenvalues, eigenvectors and lots of numbers. Reduced the dimension of data using PCA. The objective of the Principal Component Analysis (PCA) is to take the total variation on the training set of faces and to represent this variation with just some little variables. When we are working with great amounts of images, reduction of space dimension is very important. PCA intends to reduce the dimension of a group or space so that the new base describes the typical model of the group.
The image space is highly redundant when it describes faces. This happens because each pixel in a face is highly correlated to the others pixels. The maximum number of principal components is the number of variables in the original space. Even so to reduce the dimension, some principal components should be omitted. This means that some principal components can be discarded because they only have a small quantity of data, considering that the larger quantity of information is contained in the other principal components. The eigenfaces are the principal components of the original face images, obtained by the decomposition of PCA, forming the face space from these images. So any new face can be expressed as linear combination of these Eigenfaces [18,19].

The block diagram of PCA based Face Recognition System is shown in figure (2).

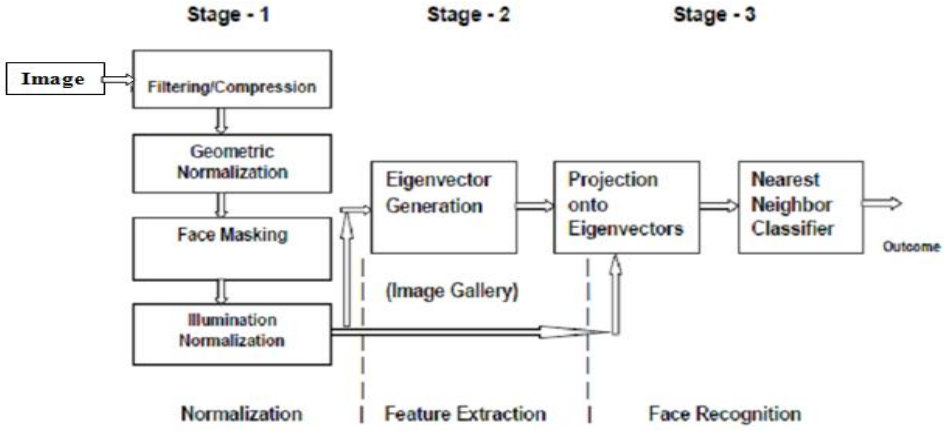

Figure 4 : Block diagram of PCA – based Face Recognition System.

Mathematically, PCA approach treats every image of the training set as a vector in a very high dimensional space. The eigenvectors of the covariance matrix of these vectors would incorporate the variation amongst the face images. Now each image in the training set would have its contribution to the eigenvectors (variations). This can be displayed as an ‗eigenface' representing its contribution in the variation between the images. These eigenfaces look like ghostly images.

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D. Local Binary Pattern

The basic local binary pattern operator, introduced by Ojala , was based on the assumption that texture has locally two complementary aspects, a pattern and its strength. In that work, the LBP was proposed as a two-level version of the texture unit to describe the local textural patterns. The original version of the local binary pattern operator works in a 3 × 3 pixel block of an image. The pixels in this block are thresholded by its center pixel value, multiplied by powers of two and then summed to obtain a label for the center pixel. As the neighborhood consists of 8 pixels, a total of $2^8 = 256$ different labels can be obtained depending on the relative gray values of the center and the pixels in the neighborhood.

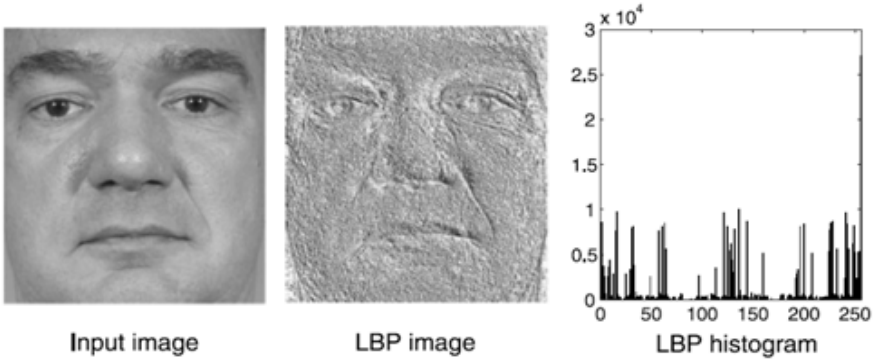

Fig. 5. Example of an input image, the corresponding LBP image and histogram

Local binary pattern (LBP) is a non-parametric descriptor, which efficiently use for summarizes the local structures of images. LBP features are in gray scale and rotation invariant texture operator. These features are more widely used for expression recognition. LBP features are also applied for face recognition task. LBP feature extraction is more faster than any other feature extraction method and it provides good performance make this most researched features.

The local binary pattern operator is an image operator which transforms an image into an array or image of integer labels describing small-scale appearance of the image. These labels or their statistics, most commonly the histogram, are then used for further image analysis. The most widely used versions of the operator are designed for monochrome still images but it has been extended also for color (multi channel) images as well as videos and volumetric data.

E.Periocular Biometrics

There is no database available with periocular region images. Only way to fetch this is using available face image. Periocular biometrics is performed in three different ways such as Non-overlapping, overlapping and Strip. Using four significant points in eye region all this three different types of periocular regions are obtained. Strip is an area below forehead and above nose considered whole region together. This strip region is cropped using outmost corner points of both the eyes. By bisecting strip into left and right region and then Overlapping periocular is obtained. Non-overlapping regions are cropped from the two corner points of each eyes separately. Lips regions are obtained using two corner points. LBP features from periocular and lips region are used in this work. PCA is used for LBP feature dimension reduction (LBP-PCA) and in turn helps in increasing the recognition rate.

F. Classification

For given test image Euclidean distance is used as the classifier to identify which training set image belongs. Classification is performed by comparing from each training set image with the test image C_{test} using Euclidean distance, ε_i.

$$\varepsilon_i^2 = (|| C_{test} - C_i ||)^2$$

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Where C_i is a shape texture parameter of the ith face image in training set. Test image is classified as belonging to image i when minimum of ε_i is below some chosen threshold value θ. Threshold value, $\Theta = 1/2 \max (|| C_{test} - C_i ||)$ where i and j are images from same class.

IV. RESULT AND DISCUSSION

The face recognition system is tested using a set of face images. All the training and testing images are grayscale images. There are 40 persons in the face image database. The training images are chosen to be those of full face scale, with face-on lighting. The performance of the Eigenface approach under different conditions is studied as follows

The robustness of the face surgical recognition algorithm (i.e. LBP-PCA approach) is studied by testing images. By using this algorithm first we use image that we want to test after that it convert in periocular form (only eyes and lips portion). These periocular images then compare with data base image and give the output result.

If the system correctly relates the test image with its correspondence in the training set, we say it conducts a true-positive identification; if the system relates the test image with a wrong person, or if the test image is from an unknown individual and the system recognizes it as one of the persons in the database, a false-positive identification is performed; if the system identifies the test image as unknown while there does exist a correspondence between the test image and one of the training images, the system conducts a false-negative detection. The experiment results are illustrated in the Table 1and shows some output images of system.

Fig. 6. shows the before and after of surgical face

Table 1. Different types of surgical face recognition

Number of test images	**40**
Number of true-positive identifications	**34**
Number of false-positive identifications	**06**

Fig. 6 shows before and after surgical face. In this image left face image shows the test image which is original (without surgery) and right side face image is surgical image. We have 40 face images after comparing all test and trail image we get maximum similar image that are surgical face. From table 1 out of 40 images we get 34 correct output, therefore from using this algorithm our project gives 84% accuracy.

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V. APPLICATION

- These applications include automated crowd surveillance, access control, face reconstruction, design of human computer interface (HCI), multimedia communication, and content-based image database management.
- Photos of faces are widely used in mug shot identification (e.g., for passports and driver's licenses), where the possession authentication protocol is increased with a photo for manual inspection purposes; there is wide public acceptance for this biometric identifier.
- Face-recognition systems are tending to intrude from a biometric sampling point of view, requiring no contact, nor even the awareness of the subject.
- The biometric works, or at least works in theory, with old or no longer used photograph data-bases, videotape, or other image sources.
- Face-recognition can, at least in theory, be used for screening of unwanted individuals in a crowd, in real time.
- It is a fairly good biometric identifier for small-scale verification applications.

VI. CONCLUSION & FUTURE SCOPE

In this project the particular method using Principal Component Analysis for facial expression detection was initially started with 3 training images and 6 testing images from each class of expression. After that the same procedure was repeated by increasing the number of training images from each class of expression and decreasing the number of testing images. The principal components are selected for each class independently to reduce the eigenspace. With these eigenvectors the input test images were classified based on Euclidian distance. The proposed method was tested on database of 30 different persons with different expressions. The proposed PCA method has the greater accuracy with consistency. The recognition rate was greater even with the small number of training images which demonstrated that it is fast, relatively simple, and works well in a constrained environment.

Future scope of this project is based on eigenface approach that gives an accuracy maximum Percentage. Adaptive algorithms may be used to obtain an optimum threshold value. There is a scope for future betterment of the algorithm by using Neural Network technique that can give better results as compared to eigenface approach. With the help of neural network technique accuracy can be improved. The whole software is dependent on the database and the database is dependent on resolution of camera. So if good resolution digital camera or good resolution analog camera is used, the results could be considerably improved.

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